Remarks

1. Status of the Claims

Claims 1-4 and 6-8 are currently pending. No claims have been amended in this response.

2. Response to Rejections under 35 U.S.C. § 103(a)

Claims 1-4 and 6-8 stand rejected under 35 U.S.C. § 103(a) as allegedly being obvious over U.S. Patent No. 5,626,922 ("Miyanaga"). Applicants submit that the Miyanaga reference does not render the invention claimed in the pending application obvious. In support of their position, Applicants submit a copy of the Declaration of Alix Gicquel under 37. C.F.R. § 1.132 ("Declaration"). Dr. Gicquel is a named inventor in the pending application and has received two Ph.D. degrees, one in chemical engineering and the other in physical sciences, and is currently employed as a Professor in Chemical Engineering at University Paris 13. (Declaration, paragraph 1.)

Independent claim 1 requires "maintaining the substrate to a temperature of between 700 °C and 1000 °C," and also requires that, "the pressure of the plasma is maintained between 100 mbar and 350 mbar." With respect to the claimed substrate temperature ranges, the Office asserted, "it would have been obvious to one of ordinary skill in the art at the time of the invention to modify Miyanaga et al. by routine experimentation… to include the claimed temperatures in order to achieve a uniform and homogenous film, absent evidence showing criticality for the claimed values." (Office Action, pages 4-5.) With respect to the claimed pressure ranges, the Office stated, "[i]t would have been obvious to a person having ordinary skill in the art at the time the invention was made to include the plasma pressures within the claimed ranges, since it has been held that where the general conditions of a claim are disclosed in the art, discovering the optimum or workable ranges involves only routine skill in the art." (Office Action, page 5.)

McDONNELL BOEHNEN
HULBERT & BERGHOFF LLP
300 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606
TELEPHONE (312) 913-0001

Despite the Office's assertions, the difference of the substrate temperature and pressure ranges of the pending application from the teachings of the Miyanaga reference are neither routine nor obvious modifications. Generally, the pending application enables rapid growth of the diamond film as distinguished from Miyanaga which, as stated by Dr. Gicquel, "discloses the use of pulse energy in order to grow diamond, [but] the growth speed is very low (Miyanaga method may apply to other objectives, such as surface control, or multi-thin-layer deoposition…), while Gicquel aims at performing the high speed growth of thick monocristaline diamond." (Declaration, paragraph 11.) Given the differences in scope of the pending application and the Miyanaga reference, the changes to the teachings of the Miyanaga reference necessary to achieve the method of the pending application would require more than mere "routine experimentation." The different temperature and pressure ranges are not merely "optimum workable ranges" for the process taught by the Miyanaga reference, in fact the process disclosed by the Miyanaga reference cannot be carried out under the claimed substrate temperature and pressure ranges. Further, the claimed substrate temperature and pressure ranges are critical to the process of the pending application.

For these reasons, which are further explained below, Miyanaga does not make the claimed invention obvious and Applicant submits that the claims are in condition for allowance.

a. A Person of Ordinary Skill in the Art Would not Achieve the Claimed Invention by "Routine Experimentation"

Some of the general differences between the Miyanaga reference and the pending application are relevant to a discussion of the claimed features. As stated by Dr. Gicquel:

> "[T]o the contrary of Miyanaga, Gicquel operates in applying pulsed energy in order to increase the gas temperature and to simultaneously reduce the volume and also the surface atomic hydrogen recombination by reducing the off plasma duration to 2 ms as well as the wall heating while choosing time parameters (of the pulsing) to control the plasma gas temperature, whereas Miyanaga only applies pulsed energy to reduce the energy consumption and improve the (diamond-like-carbon) film

McDONNELL BOEHNEN
HULBERT & BERGHOFF LLP
300 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606
TELEPHONE (312) 913-0001

properties without emphasizing details of applied microwave power density, plasma pressures or temperatures." (Declaration, paragraph 9.)

Thus, whereas the pending application applies pulsed energy to increase the gas temperature while reducing wall heating, Miyanaga applies pulsed energy to reduce energy consumption and improve film properties. (*See also,* Gicquel specification, paragraph 0054; Miyanaga, col. 1, lines 53-59.)

Dr. Gicquel also points out that:

> "Gicquel is directed to pulsed plasma rate that maintains the general thermal gas temperature of the discharge (while maintaining the microwave power at a lower value than in the non-pulsed case)... As for Miyanaga, the goal is to improve the film (mostly diamond-like-carbon) properties including crystal size, film uniformity and adhesion to substrate." (Declaration, paragraphs 7 and 8.)

Further:

> "In the pressure regime discussed by the Gicquel patent (100 mbar to 350 mbar – higher than the Miyanaga pressure range), the main mechanism is the molecular hydrogen dissociation which is thermally activated (needs gas temperature much higher than 2500 K)." (Declaration, paragraph 9.)

The claimed pressure range, which works in combination with other desired characteristics of the pending application (increased gas temperature while reducing wall heating) is inconsistent with conditions necessary to achieve the desired characteristics of Miyanaga (reduced energy consumption and improved film properties). For example, Miyanaga specifically teaches that its process is dependent upon achieving an ECR (electron cyclotron resonance) to "generate and maintain a high density plasma." (Miyanaga, col. 2, lines 63-65; *see also,* col. 6, lines 1-43, "...a favorable film is only obtainable in the region satisfying the ECR condition.") As Dr. Gicquel states, in the process claimed in the pending application, "ECR (electron cyclotron resonance) cannot occur due to the high pressure." (Declaration, paragraph 9.) Thus, a person of ordinary skill in the art would not modify the process taught by Miyanaga to be performed under the conditions

McDONNELL BOEHNEN
HULBERT & BERGHOFF LLP
300 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606
TELEPHONE (312) 913-0001

required of the pending application because, under such conditions, it would be impossible to obtain electron cyclotron resonance as required by the Miyanaga process.

Further, with respect to temperature, Dr. Gicquel points out that, "in the conditions of deposition described by Gicquel, the Diamond-Like-Carbon films of Miyanaga would be destroyed. More precisely, the DLC cannot bear temperatures higher than 500ºC (or even less, the limit depending on the microstructure and the composition of the films – amorphous carbon or nanostructured carbon with various amounts of Hydrogen)." (Declaration, paragraph 10.) The claimed substrate temperature range of between 700 °C and 1000 °C is therefore much higher than a temperature a person of ordinary skill of the art would attempt to carry out the process taught by Miyanaga. In fact, a person of ordinary skill in the art would not modify the process taught by Miyanaga to be performed under the conditions required by the pending application because, under such conditions, Diamond-Like-Carbon films would be destroyed.

Because a person of ordinary skill in the art would not be led to modify the teachings of Miyanaga to perform the method in the substrate temperature or pressure ranges required by independent claim 1, Applicant submits that independent claim 1 is not obvious.

b. The Claimed Substrate Temperature and Pressure Ranges are Critical

With respect to the claimed pressure range, such a range is critical to achieve thermally activated molecular hydrogen dissociation which results in plasma formation. (*See generally,* Gicquel specification, pages 3-4, paragraphs 0054-0056.) As stated by Dr. Gicquel, "[i]n the pressure regime discussed by the Gicquel patent (100 mbar to 350 mbar-higher than the Miyanaga pressure range), the main mechanism is the molecular hydrogen dissociation which is thermally activated." (Declaration, paragraph 9.) Generally, the required conditions, including the claimed pressure range, of the pending application make it possible "to increase the reaction rate for depositing the carbon-containing radicals contained in the plasma in the form of diamond to a high reaction rate, while guaranteeing

McDONNELL BOEHNEN
HULBERT & BERGHOFF LLP
300 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606
TELEPHONE (312) 913-0001

the electronic quality of the diamond film produced." (Gicquel specification, page 5, paragraph 0055.) Because the deposition of carbon-containing radicals is required for the manufacture of diamond film, and because the claimed pressure range is critical to plasma formation, the claimed pressure range is essential to the claimed process.

Similarly, with respect to the claimed substrate temperature range, improved efficiency is achieved as "by virtue of these arrangements [such as maintaining the substrate to a substrate temperature of between 700° C. and 1000° C.], it is possible to obtain rapid growth of a diamond film, especially of electronic quality, on the substrate." (Gicquel specification, page 2, paragraph 0045.) The combination of arrangements contemplated by the pending application including the substrate temperature, enable the rapid formation of the diamond film, and without such arrangements, formation would not occur.

For these reasons, the claimed substrate temperature and pressure ranges of independent claim 1 are critical.

3. Conclusion

Applicant respectfully contends that all requirements of patentability have been met. Allowance of the claims and passage of the case to issue are therefore respectfully solicited.

The Examiner is urged to contact the Applicant's undersigned representative at (312) 913-2114 if the Examiner believes a discussion would expedite prosecution of this application.

Respectfully submitted,
McDONNELL BOEHNEN
HULBERT & BERGHOFF LLP

Dated: August 10, 2009

By: /Bradley W. Crawford/
Bradley W. Crawford
Reg. No. 50,494

McDONNELL BOEHNEN
HULBERT & BERGHOFF LLP
300 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606
TELEPHONE (312) 913-0001